COMPARATIVE STUDY OF ASPIRATION VERSUS NON ASPIRATION TECHNIQUES OF FINE NEEDLE CYTOLOGY IN BREAST, THYROID AND LYMPHNODE LESIONS

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CERTIFICATE

This is to certify that this dissertation entitled **"COMPARATIVE STUDY OF ASPIRATION VERSUS NON ASPIRATION TECHNIQUES OF FINE NEEDLE CYTOLOGY IN BREAST, THYROID AND LYMPHNODE LESIONS"** is a bonafide work done by **Dr. K.BHARATHI,** in partial fulfillment of the requirements of THE TAMIL NADU DR.M.G.R. MEDICAL UNIVERSITY, Chennai for the award of **M.D. Pathology Degree.**

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DECLARATION

I declare that this dissertation entitled **"COMPARATIVE STUDY OF ASPIRATION VERSUS NON ASPIRATION TECHNIQUES OF FINE NEEDLE CYTOLOGY IN BREAST, THYROID AND LYMPHNODE LESION"** has been done by me under the guidance and supervision of **Prof. Dr. SUDHA VENKATESH, M.D.** It is submitted in partial fulfillment of the requirements for the award of the M.D., Pathology degree by The Tamilnadu **Dr. M.G.R. Medical University**, Chennai. This has not been submitted by me for the award of any degree or diploma from any other University.

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ABBREVIATIONS

FNC	-	Fine needle cytology
FNNAC	-	Fine needle non aspiration cytology
FNAC	-	Fine needle aspiration cytology
IHC	-	Immuno histochemistry
H&E	-	Hematoxylin & Eosin staining
MGG	-	May Grunwald Giemsa staining
P	-	Probability

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INTRODUCTION

Fine needle cytology (FNC) has gained tremendous popularity in recent times among the clinicians and the pathologists. It is easy to perform, quick and has a high degree of specificity and sensitivity. FNAC and FNNAC are the two techniques of fine needle cytology (FNC). FNC is used to sample all superficial mass lesions and even deeply seated lesions. Deeply seated lesions can be sampled with the aid of imaging techniques. The basic principle underlying fine needle aspiration cytology is the aspiration of cellular material from the target masses often utilizing fairly high suction pressure. The procedure requires a needle and a syringe advisedly held in a syringe holder enabling single handed suction to be exercised. This technique depends on the suction and is painful, traumatic and can cause hematomas as well as yield hemorrhagic material. In more recent times a modified technique called fine needle non-aspiration cytology (FNNAC) , pioneered in France came into vogue in 1981. It eliminates active aspiration by syringe, replacing it by the principle of capillary suction of fluid or semi fluid material into a thin channel (fine needle). It is less painful, less traumatic, and patient-friendly. Smears obtained by FNNAC are of “text book” quality. In this prospective study of 160 cases, an attempt is made to compare both the techniques FNAC and FNNAC with reference to diagnostic adequacy and diagnostic accuracy.

AIMS & OBJECTIVES

1. To do both Fine needle aspiration (FNAC) and Fine needle non aspiration (FNNAC) techniques for fine needle cytology in breast, thyroid and lymph node lesions .
2. To compare the quantum of yield in the two techniques.
3. To compare the cytomorphological details in the two techniques.
4. To compare the quantum of trauma by each technique.
5. To find out any specific form of lesions of thyroid , breast and lymph node where the two techniques could be specifically used for diagnosis.
6. To assess the diagnostic superiority of the two techniques.

REVIEW OF LITERATURE

During Medieval times, the Arabian physician Abul Casim (1013 – 1107AD) described a method of needle puncture of thyroid to diagnose different types of goitre.

Needle aspiration biopsy was first recorded by Kun in 1847. Pravaz in 1853 developed a metallic syringe for treatment of aneurysms, Leyden used it for trans thoracic needle aspiration to obtain organisms from pneumonia patients. In 1884, Kronig was the first to diagnose lung cancer by aspirating tissue through a transthoracically inserted cannula. In 1904 Greig and Gray performed aspiration of lymph nodes to isolate causative agents of trypanosomiasis . During this aspiration he noticed that the cells aspirated from lymph nodes might help in diagnosis. After that the growth of FNB remained dormant.

In the late 1920s and 1930s, there was a brief flowering of interest in the classic papers of Dudgeon and Patrick from England who used cytologic scrap preparations of excised tissue. They also proposed needling of tumours as a means of rapid diagnosis. Guthrie in 1921 successfully diagnosed cases of syphilis, tuberculosis, lymphomas and metastatic carcinoma by needle aspirations.

During the same period (late 1920s), Papanicalou made his greatest contribution to the field of exfoliative cytopathology, presented his paper “new cancer diagnosis”, later known as pap smear . Pap smear was both screening and diagnostic test for cervical cancer.

In 1930, Martin , Stewart and Ellis from United States described the diagnosis of Thyroid nodules by needle biopsy . They used a thicker needle (18 gauge) for aspiration. This technique did not gain wide acceptance because of fear of malignant implant along the needle tract and the other complications.[1]

After World war II, in 1960s, the Europeans particularly Scandinavians re-introduced a special aspiration biopsy for diagnosing thyroid lesions. But they performed the aspiration with a finer needle ie, 22 – 25 gauge. The FNAC technique which was described by Lowhagen et al from Karolinska Institute is generally employed now.[2]

In 1955, Franzen et al[3] introduced a special aspiration syringe holder described in detail in 1960 – 1967. However FNAC came into wide acceptance in North America and India in 1980s. Since 1981 , a new modified technique of FNC termed as FNNAC pioneered in France by Zajdela et al[4] came into vogue. The same procedure was called as “cyto puncture ” by Brifford et al[5] in 1982.

According to Thomson et al ., the function of the negative pressure in FNAC is not to tear cells but to hold the tissue against the sharp cutting edge of the needle which scrapes or cuts the tissue as it advances through the tissue.[6] FNNAC technique has gained popularity nowadays for its various advantages and has been used widely.

Santos and Leiman et al[7]., in 1988 were the first to compare the FNAC and FNNAC smear in thyroid nodules. They observed that the number of unsuitable

specimens in their study was not different with both the techniques. They compared the two techniques and graded them on the basis of certain criteria ie., **Unsuitable** – If the smears consisted mainly of blood or if cellular material was absent. **Diagnostically adequate** - If the smears were adequate enough to render the diagnosis, but the cellularity is suboptimal and if there was degenerative changes or specimen entrapment in clots. **Diagnostically superior** - If the cells or cell groups are concentrated , well preserved , unobscured by background blood and excellently displayed with retention of such architectural structures such as follicles, papillae and flat sheets.

Sharon Mair and Fiona Dunbar et al[8] in 1989 did their comparative study of FNAC and FNNAC and the smears were scored on the basis of following five objective parameters diagnostic adequacy , retention of architecture, degree of trauma, degree of cellular degeneration and background blood or clot obscuring the background as shown in table 1.,

TABLE - 1

Criterion	Quantitative description	points
Amount of cellular material	Minimal to absent; diagnosis not possible	0
	Sufficient for cyto diagnosis	1
	Abundant	2
Retention of appropriate architecture	Minimal to absent ; diagnosis not possible	0
	Moderate ; some preservation of architecture	1
	Excellent ; architecture display closely resembling histology , diagnosis obvious	2
Degree of cellular degeneration	Marked; diagnosis impossible	0
	Moderate; diagnosis possible	1
	Minimal diagnosis obvious	2
Degree of cellular trauma	Marked; diagnosis impossible	0
	Moderate; diagnosis possible	1
	Minimal diagnosis obvious	2
Background blood or clot	Large amount ; great compromise to diagnosis	0
	Moderate amount ; diagnosis possible	1
	Minimal; diagnosis easy; specimen of textbook quality	2

The smears were classified as

1. Diagnostically Unsuitable -- score 0-2.

2. Diagnostically Adequate -- score 3- 6.

3. Diagnostically superior – score 7-10.

This study concluded that there was no statistical difference between FNAC and FNNAC, but they observed that FNNAC smears were diagnostically superior and of text book quality and it allows for greater ease of sampling and a more sensitive probing of the mass to be sampled. FNAC was diagnostic for fibrous lesions and cystic lesions and suggested that the technique of fine needle sampling employed for cytodiagnosis could be left to the personal preference of the operator.

Rajasekhar A and Sundaram C et al[9] in 1991 observed that efficiency of obtaining adequate material was 80% for both the techniques and FNNAC was more cost effective and less painful . FNNAC showed a diagnostic accuracy that correlated well with FNAC and histopathology. Malignant lesions were sampled more easily. Anatomic site had no influence on the yield. Most of the negative cases were small swellings, less than 1.5 cm in diameter.

Dey P and Ray R et al[10] in 1993 assessed the quality of diagnostic material of FNAC and FNNAC using a scoring system based on cellularity and amount of blood in the smear . They found that total score of FNNAC was significantly higher than

FNAC, The FNNAC procedure was less traumatic and equally cost effective and can be safely undertaken in liver, orbital and thyroid lesions. In lymph nodes, especially in children, FNNAC gave an excellent cellular yield. However, this procedure could not be advocated in cystic, bony and fibrous lesions.

Thomas B Kinney and Michael J Lee et al[11] in 1993 did a comparative study in the mass lesions of abdomen and concluded in their study that there was no significant difference between the two techniques,. The aspiration technique was found to be superior to Non Aspiration technique in the abdominal mass lesion.

Kumarasingh M , Sheiffdeen AH et al [12] in 1995 observed in their comparative study that FNNAC was superior to FNAC in thyroid, FNAC was superior to FNNAC in benign lesion of breast . In case of malignant lumps of breast and in all lymphnode lesions both the techniques was comparable. Carrie A Savage, Kenneth D Hopper et al [13] in 1995 observed in their comparative study that there was no significant difference in performance and diagnostic yield between FNAC and FNNAC of the mass lesions of thorax, abdomen and pelvis.

Salim Akhthar , Imran ul Huq et al[14] in 1997 observed that FNNAC was superior to FNAC in cellularity in the lesions of lymph node and the failure rate was lower with FNAC but there was no statistically significant difference.

Braun H, Walch C, Beham et al[15] in 1997 observed in their comparative study that FNNAC offered several advantages. Without aspiration, trauma to cells and tissues

was reduced. Less blood in the samples resulted in higher quality of the cytological smear. These circumstances made it easier for the pathologist to comment accurately on the cytological findings. The handling of the needle was practised with a wrist movement and not from the shoulder joint as in aspiration method using the Cameco syringe holder. This allowed for a more sensitive puncture technique touching the lesion during sampling with the finger tips. The puncture caused less pain than the aspiration technique. They demonstrated that fine needle capillary technique was the better method of fine needle biopsy in the head and neck region.

Amrita Ghosh , Rajiv kumar Misra et al[16] in 2000 did a comparative study and found that contamination with blood was more in lymphnode, thyroid and liver lesions in aspiration smears than FNNAC smears and values were statistically significant. Similarly when compared for the degree of cellular trauma and cellular degeneration, statistically significant better results were obtained by nonaspiration technique for lymphnode lesions. Regarding amount of cellular material obtained by FNAC, statistically significant better results were found for breast lesions only. Statistically significant better maintenance of architecture was observed only for thyroid lesions by FNNAC technique. Better average scores were observed by FNNAC technique for lymphnode and thyroid only.

Categorizing all the smears obtained by FNAC & FNNAC on the basis of their scores according to predetermined criteria, greater number of diagnostically adequate specimens were obtained by FNAC than by FNNAC but the number of diagnostically superior specimens obtained by FNNAC technique was found to be more than that by

FNAC. The difference was found to be statistically significant. However the number of inadequate smears was also more by FNNAC technique than by FNAC technique.[16] It was also observed by them that both the techniques have their own advantages and disadvantages. Therefore it was concluded that by combining both the techniques better diagnostic accuracy can be achieved.[16]

Meherbano M Kamal , Dilip Arjuna et al [17] in 2002 designed a comparative study for both the techniques in thyroid lesions. A statistically significant difference in favour of FNNAC was observed for the parameter amount of cellular material. For the rest of the parameters namely, background blood or clot, degree of cellular degeneration, degree of cellular trauma and retention of architecture--the average score favoured FNNAC but was not statistically significant--i.e., smears prepared from FNNAC displayed cellular material that was more concentrated, less damaged and less likely to be obscured by blood.

They concluded that although FNNAC sampling was diagnostic in a greater number of cases than FNAC sampling, this study did not prove a clear superiority of FNNAC over FNAC. Until greater experience shows clear sampling superiority of FNNAC alone, rather than performing only FNNAC in diffuse or nodular thyroid lesions, incorporating FNAC into the second puncture will definitely improve the quality and quantity of material at the patient's first visit.[17]

C V Raghuveer I Leeka et al[18] in 2002 observed in their comparative study that FNNAC was superior in quality and diagnostic accuracy than FNAC in thyroid and

lymph node lesions. FNNAC seemed to be better for diagnosing malignant lesions while FNAC appeared better for diagnosing benign ones. In the salivary gland lesions, both FNNAC and FNAC fared equally well. On the whole FNNAC technique was much more patient friendly and gave high class "text book" quality smears while FNAC smears gave quantitatively more adequate material. Both the techniques therefore would be complementary to each other.

Shahram Hadadi Nizhad, Bagher Larijani et al[19] in 2003 did a comparative study in thyroid lesions The specimens were scored (0, 1, or 2) on the basis of background blood or clot, number of obtained cells, preserved architecture of papillae and follicles, and cellular degeneration. Nonparameteric methods were then used to compare the scores of the two techniques. They concluded that FNNA is not superior to FNA in the cytopathologic studies of thyroid nodules.

Ceresine G, Corcione L et al [20] in 2004 found that inadequate samples may occur in thyroid FNAC leading to a repetition of the procedure with the consequence of patients' discomfort and poor compliance. In this paper, they presented results from biopsy of thyroid nodules obtained by combining: (1) ultrasound (US) guidance, (2) non -aspiration technique, and (3) on-site review of specimen and concluded that the combination of US guidance, capillary collection with no-aspiration technique, and on-site review of slides, characterizes an advantageous method for thyroid nodule fine-needle biopsy.

Baksh S , Masih K et al[21] in 2004 designed a study to assess the diagnostic utility of FNNAC and FNAC in breast masses and found that differences between all the

individual parameters as observed in FNAC and FNNAC smears were insignificant. After evaluation of FNNAC and FNAC on the basis of these scores, greater number of diagnostically superior samples were obtained by FNNAC; however by FNAC more number of diagnostically adequate smears were observed. This difference was statistically significant. The number of unsuitable smears were also more by FNNAC technique.

Yasub E Al Khattab et al[22] in 2004 observed that each sampling technique has its own advantages and disadvantages and to choose one of them was based on personal preference . They suggested that if only one needle pass was to be performed or to minimize the patient discomfort or to reduce the screening time, FNAC probably has the greater chance of producing a diagnosis than FNNAC.

S A Ali Rizvi , M Hussain et al[23] in 2005 observed that the non-aspiration technique yielded more diagnostically adequate specimens in thyroid lesions, as compared with FNAC. The number of unsuitable smears was also greater in aspiration samples, as compared with the non-aspiration technique. The non-aspiration technique was simple, easy to perform and produced better results in the form of a better quality of the cellularity and less field obscurity by blood in both neoplastic and non-neoplastic lesions of the thyroid. This technique should be used alone or in tandem with FNAC for better diagnostic yield.

Ricardo S Cajulin , Nour Senuge et al[24] in 2006 did a comparison to determine objectively the adequacy of cell yield both for diagnosis and for special studies (e.g.,

flow cytometry, markers). Two needle passes for each method were placed in separate tubes of RPMI medium. The cell counts were determined by a Coulter counter for both the techniques. Both techniques provided adequate numbers of cells for special studies in all cases while they concluded that FNNAC can provide an adequate number of cells both for diagnosis and for special studies.

Stefano Ciatto , Selvatone et al[25] in 2006 observed in breast lumps that reducing the rate of inadequate sampling from benign masses seemed to be the major advantage of aspiration. Double sampling, independent of the specific techniques, reduced inadequacy rates to very low levels (1.2% for cancers; 5.9% for benign masses) and may be useful as a routine policy.

David D Pother , AA Narula et al[26] in 2006 did a literature search and a systematic review was undertaken, looking for prospective trials to compare the two methods . Criteria for inclusion of studies into meta-analysis were: (i) randomised controlled trials or cross-over trials; (ii) blinded randomisation allocation; and (iii) blinded cytopathologist. The outcome measures were: (i) adequacy of sample for diagnosis; and (ii) reliability of diagnosis made.

The following papers fulfilled the inclusion criteria: Haddad-Nezhad *et al*., Ghosh *et al*. , Mair *et al*., Raghuveer *et al*. and Santos and Leiman.

All used the same method of double sampling each thyroid lesion by FNAC and FNNAC. The first four studies all used the same technique for assessing the aspirate.

This was achieved by the use of a point-scoring system devised by Mair *et al*. Santos and Leiman used a different system where each sample was categorised into diagnostic superior, diagnostic or unsuitable. This study was not included in the meta-analysis. Although there have been five high-quality trials on the subject, there was no evidence from a meta-analysis that one method of collection of cytological material was better than another in the investigation of thyroid lesions. Taking into consideration all the data entered into the meta-analysis, there seems to be some evidence favouring FNNAC.[26]

Storch I M , Surman DA et al[27] in 2007 did a study to evaluate the specimen quality of the two techniques which were done under ultrasound guidance and concluded that no difference exists between quality and diagnostic accuracy of specimens obtained from EUS-guided tissue acquisition via FNC and FNA. The decision to use FNNAC or FNAC should be left to the discretion of the individual endosonographer.

Mitchell E Tubulin, Joseph A Martin et al[28] in 2007 did a study to compare USG guided FNNAC and FNAC in thyroid nodules and observed that the results were comparable with equivalent diagnostic yields. The technical ease of capillary sampling may prompt adoption of FNNAC at high volume endocrine and radiology practices.

Federico Ronietelli , Enrico Distasio et al [29], in 2009 did a similar comparative study like Mitchell E Tubulin et al ., and found that there was statistical difference between two techniques only on the number of inadequate results. However they

concluded that due probably to its minimally invasive procedure, better quality of smears , reduced inadequate results , FNNAC should be preferred for FNAC in cytological evaluation of thyroid nodules.

ADVANTAGES AND LIMITATIONS OF FINE NEEDLE CYTOLOGY (FNC)

Fine needle cytology includes both FNAC and FNNAC. Fine needle cytology has clear advantages both to patients and clinicians. This technique is simple, relatively painless, OP procedure, produces a speedy result and is economical.[30-32] The accuracy can approach to that of histopatholoy in providing an unequivocal diagnosis when applied by experienced, well trained practitioners. Though not a substitute for conventional surgical histopathology, it is an extremely valued complement to it.

FNC can be employed on all the lesions that are easily palpable. eg,. superficial nodules of skin, subcutaneous tissue , thyroid, breast & lymph node. Radiologic guidance eg, USG and CT is required for sampling the deeply seated lesions. Latest is the endoscopic ultrasound guided FNC .[33]

In fact FNC , as the first step in laboratory investigation can satisfy the avidity of clinicians for rapid diagnosis. The expansion of FNC in primary diagnosis of tumours has been enormous and successful. It is less demanding technologically than surgical biopsy. The low risk of complications is an additional advantage which allows FNC to be performed as an office procedure in outpatient departments and in Radiology rooms. It is also highly suitable for debilitated patients. FNC is readily repeatable and as

a preliminary investigation can reduce the hospitalisation period and overcrowding in hospitals.

The clinical value of FNC is not only limited to neoplastic conditions but it is also valuable in the inflammatory , infective and degenerative conditions in which the samples can be used for microbiological and biochemical analysis in addition to cytological preparations.[33]

ANCILLARY TECHNIQUES USED IN FNC

Recently due to advances in scientific technologies , many ancillary techniques can be used in cytology to aid in correct and rapid diagnosis.

SPECIAL STAINS

The common special stains that are employed in histopathology can be used in used in cytology. Some of them are PAS / diastase for glycogen , Alcian blue for mucins , Prussian blue for iron, Masson Fontana for melanin, Grimelius for argyrophilic granules, Congo red for amyloid , Ziehl Neilson for acid fast organisms. Oil red O for fat in air dried smears.[35]

PHASE CONTRAST MICROSCOPY

Phase contrast microscopy of unstained smears has been used in cytology to

check the quality and the representativeness of the smears to be used for Immunoperoxidase staining or for Electron microscopy, so that time and reagents are not wasted on unsatisfactory samples.[36]

ELECTRON MICROSCOPY

This modality is mainly used in association with FNC at all sites mainly in deep aspirations. EM is particularly used in unusual lung and mediastinal lesions. The most commonly used method of fixation is to eject the aspirate into the small test tube containing glutaraldehyde. For a highly cellular dry aspirate , the material can be ejected as semisolid droplet onto a carefully cleaned slide which is then immersed in a glutaraldehyde fixative. Lazzaro's method of cell concentration can be used for separating tumour cells from contaminating red cells. The small pellet produced by centrifugation can be carefully removed and used for further processing.[37 -39]

IMMUNOCYTOCHEMISTRY

This is probably the most important recent development in diagnostic cytology. The increasing availability of monoclonal antisera to a variety of proteins and the other cell products which are more or less specific to different cell lines and the demonstration of such cell products by immuno cytochemical methods is of immense value in diagnostic cytology. The avidin – biotin complex method is the most commonly used with both monoclonal and polyclonal primary antibodies. Diaminobezidene is used as the marker dye. Immune alkaline phosphatase staining appears to offer several advantages in cytological preparations. Commercially produced kits have made immuno

cytochemistry a relatively simple method available to any cytology laboratory. Appropriate controls are crucial to achieve diagnostic accuracy.[40, 41]

The other new techniques that can be applied to cytologic samples are image analysis which deals with different areas namely morphometry , object counting and cytometry. Flow cytometry and molecular cytometry can also be employed.

LIMITATIONS OF FNC

FNC is still a relatively a new discipline and experience in this field is still insufficient . The diagnostic criteria need to be better defined in some less common conditions like soft tissue tumour , pediatric tumours etc., where specialised onclogical expertise is necessary. Deep seated lesions cannot be reached by the needle, so image guidance is necessary under these circumstances. Some minor complications like hematoma, pain and hemorrhage can occur. Another concern is that FNC may cause changes in the tissue which may render subsequent diagnosis difficult. Some of these changes are infarction, pseudo capsular invasion, pseudo malignant changes, and reparative reactions. So the FNC technique should always be done carefully and gently to minimize tissue damage.

The possibility of cancer cells being disseminated along the needle tract caused a great deal of concern initially, but the review of literature on the reported cases of tumor implantation along the needle tract by Roussel et al in 1989 and Power et al in 1996, proved that the risk of needle tract seeding is extremely low in case of FNC when truly

a fine needle(22-25 gauge) is used.[34] Multiple passes , larger needles and absence of normal parenchyma covering the lesion appear to increase the risk. Some extremely rare complications of FNC especially when applied to deeper organs are hemorrhage, septicaemia, bile peritonitis, acute pancreatitis, pneumothorax etc., where close follow up of patients is the rule.

FNC OF THYROID

Fine needle cytology of thyroid has been established as a first line diagnostic test for the evaluation of goitre and the single most effective test for the preoperative diagnosis of a solitary nodule. The main indications for FNC are diffuse non toxic goitre , solitary or dominant thyroid nodule and to confirm a clinically obvious thyroid malignancy. FNC can reliably confirm benignity in about 60% of benign thyroid nodules. In diffuse non toxic goitre, FNC provides reliable distinction between colloid goitre and autoimmune thyroiditis since the treatment is different for both. Antibody levels and TSH level estimation was also useful to confirm the diagnosis. [42]

The main limitation of thyroid FNC was the inability to distinguish between follicular adenoma and carcinoma. This distinction depends mainly on the demonstration in tissue sections of capsular invasion or vascular invasion. In papillary carcinoma of thyroid, the recognition of the characteristic nuclear morphology of papillary carcinoma is easier in cytology smears. The complications associated with thyroid FNC are hematoma, transient laryngeal nerve palsy, puncture of trachea causing coughing spasms, organisation of hematoma and necrosis which can mimic a sarcoma

or angiomatous tumor. Damage to the capsule by needling may simulate capsular invasion.[43]

FNNAC provides better, cleaner, and less hemorrhagic material. For the cystic lesion , a syringe is attached , the fluid is drained and the FNC is repeated in the residual lesion. Ultrasound imaging is of particular value in cystic nodules reducing the risk of false negative diagnosis. It allows the sampling of very small nodules. The technique may need to be modified depending on the consistency and the vascularity of the lesion. In Hashimotos thyroiditis, the gland is firm and not very vascular. Colloid nodules may have a fibrous outer capsule but do not have a hard or firm center except in a foci of fibrosis and calcification. Thin colloid smears look like a clear varnish and thick inspissated colloid as a jelly like substance. Follicular neoplasms are very vascular. The nonaspiration technique is particularly suitable for such lesions. Hamburger et al[44] suggests that in the assessment of dominant nodule 6 clusters of benign cells in at least two slides prepared from separate aspirates constitute reasonable minimum material for diagnosing benign lesions.

FNC OF BREAST

FNC and mammography as complements to clinical examination (triple diagnosis) have become the standard approach to the investigation of palpable breast lumps. The trend towards more conservative surgery and individualised treatment has increased the importance of triple diagnosis. The aspirated material can also be used for hormone receptor analysis by IHC methods. The main purpose of FNC of breast lumps

is to confirm the cancer and to avoid the unnecessary surgery in specific benign conditions. Subjective cytological grading correlates with nuclear and histological grade and shows some correlation with prognosis.[45]

The sensitivity of FNC in the diagnosis of breast cancer is 90 – 95 % . However radiation induced atypia in benign glandular epithelium does create some risk of over diagnosis of malignancy.[46] Under certain conditions well circumscribed lesions such as simple cyst , lipomas, most fibroadenomas, intra mammary lymphnodes and fat necrosis can be diagnosed with confidence. Poorly circumscribed lesions like common hormonal mastopathy, fibrocystic disease, fibroadenosis, mammary dysplasias cannot be confidently diagnosed by FNC. In a study by Layfield et al [47] six clusters of benign epithelial cells were used as the threshold for a satisfactory sample. One cannot expect to obtain many cells from a fibrous mastopathy, from a sclerosed fibro adenoma, from a carcinoma with high desmoplastic stroma or from a hypertrophic adipose tissue.

Complications are uncommon. Minor haemorrhage and pain can occur. Major hematoma, pneumothorax and subpleural hematoma are the very rare complications.[48] The impalpable lesions detected by screening mammography can be investigated by image guided needle sampling now a days.

FNC OF LYMPHNODE

The commonest cause of peripheral lymphadenopathy is a reaction to some symptomatic inflammatory process. Although surgical excision of a palpable peripheral

node is relatively simple, FNC offers an alternative of an immediate, preliminary test with little trauma and cost. FNC of lymph nodes has been practised in Central Europe and in Scandinavia for many years, particularly by haematologist in conjunction with aspiration of bone marrow and spleen.[49]

The primary purpose of FNC of an abnormal peripheral lymph node is to decide whether surgical excision for histological examination is indicated. As a rule, the cytological examination can decide whether the lymphadenopathy is due to reactive hyperplasia , metastatic malignancy or malignant lymphoma. The ever-increasing number of commercially produced monoclonal antibodies to various antigens specific to different cell lines is found to be very useful in lymph node cytology especially in diagnosis and sub typing of lymphoma .The accuracy of FNAC of lymph node is influenced by size, site of node, fibrosis, previous irradiation and number of punctures made. [50]

Both the reactive nodes and nodes involved by metastatic malignancy or lymphoma are highly cellular and moderately vascular tissues. Sufficient material can be obtained by 27 -23 gauge needle except in the presence of fibrosis. FNNAC has the advantage over the traditional FNAC of giving the operator a more direct and better feeling of the consistency of tissues through the tip of the needle and little admixture of blood.

MATERIALS AND METHODS

This study was conducted at Goschen Institute of Pathology , Madras Medical College during the year 2008 – 2009. This study included samples obtained from 160 patients who attended the cytology department for FNC of thyroid, breast and lymph node lesions.

METHODS

Samples were obtained from thyroid , breast and lymph node by doing :

1. Fine needle non aspiration cytology (FNNAC)
2. Fine needle aspiration cytology (FNAC)

FINE NEEDLE ASPIRATION CYTOLOGY – PROCEDURE

Equipments needed: [picture 1]

(27-22 gauge) needles, 10 ml Syringe/syringe holder, gloves, Fixative, Coplin jars, lidocaine, cotton/skin disinfectant, glass slides, glass marking pencil, stains, sterile test tube for collecting any fluid or pus from cystic lesions.

PATIENT PREPARATION

A clear explanation was given to the patient about the procedure, number of pricks that would be made and the complications of the procedure. A written consent was obtained first and the cooperation of patient to procedure is very essential.

The procedure was normally carried out with the patient lying supine on the examination couch.

The swelling was located and palpated, then skin overlying was cleansed with alcohol. A 10 ml plastic syringe attached with a needle (22 gauge or 25 gauge) was held in the right hand. Two fingers of the left hand firmly grasp the nodule. Then the needle was rapidly inserted through the skin into the nodule. Once the needle tip is in the nodule, gentle suction was applied while the needle is moved back and forth in the nodule vertically. This manoeuvre allows the dislodging of cellular material and easy suction into the needle . During this period of 5-10 passes, suction was maintained and as soon as fluid or aspirate appears in the hub of the needle, the suction was released and the needle was withdrawn [picture3].

The appearance of fluid suggests that nodule is cystic . The suction pressure is maintained to aspirate all the fluid and then FNAC was to be done in the residual lesion or mass. Once the material is seen in the hub of the needle, the needle is taken out of the swelling and detached from the syringe. 5 ml of air was drawn into the syringe and the needle was reattached to the syringe and with the level pointing down, drop of aspirated material was forced onto each of the several glass slides. It is important that all the slides are labelled and placed in order on a nearby table before the aspiration smears are prepared

FINE NEEDLE NON ASPIRATION CYTOLOGY – PROCEDURE

For this technique, patient preparation is similar to that of FNAC . However no syringe or suction is necessary for this technique. After identifying the swelling with all sterile precautions, the hub of the needle is held in the pencil grip fashion in the right hand and the needle was gently inserted into the swelling and then moved in and out over 5-10 seconds rapidly. [picture 2]

Aspirate flows into the needle through capillary action and as soon as the aspirate appears in the hub , the needle is withdrawn and attached to the syringe with air inside. Next the plunge is used to expel the material from the needle onto the glass slides. The procedure is repeated and slides are prepared as that of the FNAC. After the procedure is over, firm pressure was applied to the aspirated site with cotton. Once the bleeding has stopped, adhesive bandage is placed on it. The patient is observed for few minutes and if there are no problems, he/she is allowed to leave.

PREPARATION OF SMEARS

The aspirate contained in the needle was expelled on to a clean glass slide using air in a syringe, taking care to avoid splashing. The smears were prepared by using a second glass slide exerting a light pressure to achieve a thin, even spread, in a manner similar to that of making blood smears. Too firm pressure produces crush artefacts . The slides were fixed in 85% of the Isopropyl alcohol in Coplin jars.

STAINING PROCEDURE

The slides were fixed in 85% Isopropyl alcohol for 20 -30 minutes. The slides were stained with Harris Hematoxylin for 5 to 8 minutes , washed in water, followed by differentiation by dipping in 0.5% acid alcohol for 3 to 5 seconds. After rinsing the slides in water, blueing was done by placing the slides in running water for 10 to 20 minutes. Then the slides were dipped in 1% aqueous Eosin once. The slides were then washed in water. Finally the slides were dried and mounted in D.P.X.

All the needle sampling procedures were made by a single operator, bias was thus avoided in all stages of sampling from patient examination to slide fixation. The slides were studied and a cytological diagnosis was made All the slides were objectively analysed using a point scoring system to enable comparison between FNAC and FNNAC techniques as shown in Table 2.

TABLE – 2

Scoring system developed by Mair *et al* [8] to classify quality of cytological aspirate

Criterion	Qualitative description	Point score
Background blood or clot	Large amount; great compromise to diagnosis	0
	Moderate amount; diagnosis possible	1
	Minimal diagnosis easy; specimen of 'textbook' quality	2
Amount of cellular material	Minimal to absent; diagnosis not possible	0
	Sufficient for diagnosis	1
	Abundant; diagnosis simple	2
Degree of cellular degeneration	Marked; diagnosis impossible	0
	Moderate; diagnosis possible	1
	Minimal; good preservation; diagnosis easy	2
Degree of cellular trauma	Marked; diagnosis impossible	0
	Moderate; diagnosis possible	1
	Minimal; diagnosis obvious	2
Retention of appropriate architecture	Minimal to absent; non-diagnostic	0
	Moderate; some preservation of, for example, follicles	1
	Excellent architectural display closely reflecting histology; diagnosis obvious	2

On the basis of five criteria tabulated , a cumulative score was obtained for each case which was then categorized accordingly to one of the 3 categories

1. Unsuitable for cytological diagnosis- (0-2)

2. Diagnostically Adequate- (3-6)

3. Diagnostically superior - (7-10)

STATISTICAL FORMULA USED TO ANALYSE THE RESULTS

All the results were interpreted statistically using Z test or student's 't'- test

S.No.	FORMULA & ABBREVIATIONS	
1.	Standard error of difference between two proportions	$\sqrt{[p_1q_1/n_1 + p_2q_2/n_2]}$
2.	Z score for standard error of difference between two proportions	p_1-p_2/standard error of difference between two proportions
3	p	Probability
4.	P<0.05	Statistically significant at 5% level.
5.	P>0.05	Not statistically significant at 5% level.
6.	P_1	proportion of cases (1st category)
7.	P_2	proportion of cases (2nd category).
8.	q_1	$1-p_1$
9.	q_2	$1-p_2$

OBSERVATION AND RESULTS

TOTAL NO OF CASES STUDIED - 160

THYROID SWELLING - 60

LYMPH NODE SWELLING - 50

BREAST LUMP - 50

RESULTS OF FNC OF THYROID

In the 60 cases of thyroid swelling , there were 6 males and 54 females. Out of which there were 35 cases of nodular colloid goitre, 14 cases of auto immune thyroiditis (Hashimotos thyroiditis & lymphocytic thyroiditis), 6 cases of cystic colloid nodules, 3 cases of papillary carcinoma and 2 cases of follicular neoplasm.

TABLE - 3

Total cases of thyroid	60
Male	6
Female	54

TABLE – 4

S.no	Diagnosis	Total
1	Hashimotos thyroiditis & Lymphocytic thyroiditis	14
2	Nodular colloid goitre & colloid goitre	35
3	Cystic colloid nodules	6
4	Papillary carcinoma	3
5	Follicular neoplasm	2
6	Total no of cases	60

The smears obtained by FNAC & FNNAC from thyroid lesions was scored and graded accordingly. It was found that the number of diagnostically superior smears was more from FNNAC technique (27 vs 10) whereas the number of number of diagnostically adequate and diagnosticaly unsuitable smears were more from FNAC technique (table 5).

TABLE - 5

S. NO	GRADING OF SMEARS	FNNAC	FNAC
1	Diagnostically unsuitable	12	14
2	Diagnostically adequate	21	36
3	Diagnostically superior	27	10
4	Total	60	60

FIGURE - 1

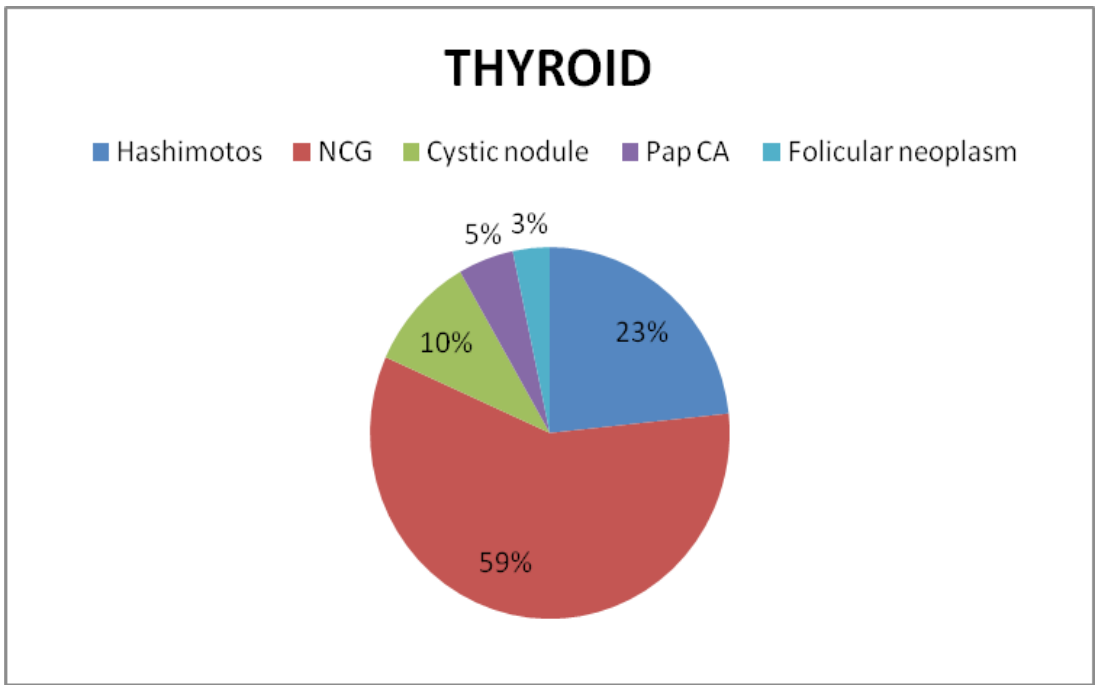
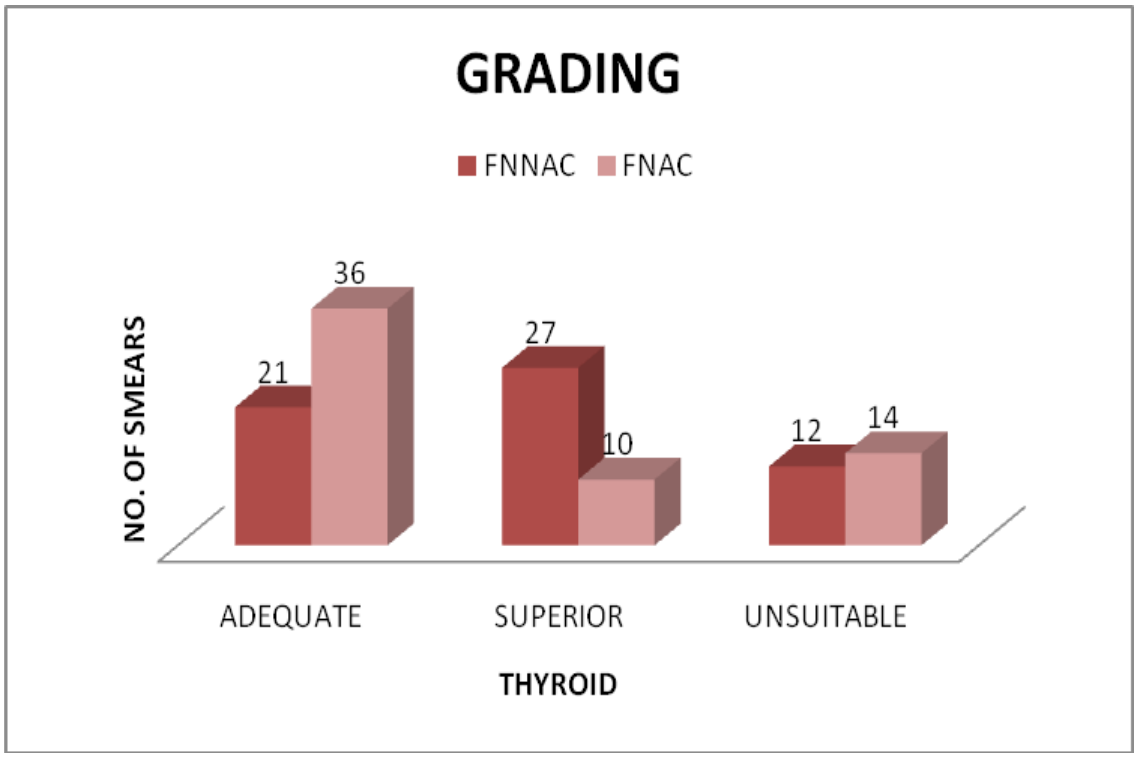


FIGURE 2: GRADING OF SMEARS IN THYROID LESIONS:



On comparing the number of superior quality smears obtained by FNNAC and FNAC, it was found that FNNAC technique produced more number of superior quality

smears and it was found to be statistically significant ($P<0.05$)

TABLE - 6

Comparison of the number of superior quality smears from both techniques: (Thyroid)

FNNAC	FNAC	Standard error of difference between two proportions	Z score	P value
27	10	8	3.55	P< 0.5

After adding up all the scores, a total average score per case as well as average score for each parameter in each case were obtained and tabulated. The average score obtained by FNNAC from thyroid lesions is 5.7 whereas by FNAC is 4.8. [table 7]

TABLE - 7

TOTAL AVERAGE SCORE		
1	FNNAC	5.7
2	FNAC	4.8

The average score for each parameter in FNNAC and FNAC of thyroid lesions was calculated and it was found that the scores were numerically higher for FNNAC technique. [Table 8]

TABLE - 8

Average scores of FNNAC & FNAC in thyroid lesions						
s. no	**Technique**	**Adequacy**	**Architecture**	**Cellular degeneration**	**Cellular trauma**	**Background blood**
1	FNNAC	1.445	1.2675	1.1	1. 083	1.1
2	FNAC	1.325	1.055	0.96	0.86	0.816

The diagnostic adequacy was 81.6% from FNNAC while it was 75% from FNAC technique in thyroid lesions. Although it was higher for FNNAC technique, statistical analysis proved it to be statistically insignificant.[table 9]

TABLE - 9

DIAGNOSTIC ADEQUACY		
1	FNNAC	81.6%
2	FNAC	75 %

Average score obtained under each sub category inThyroid lesions:

FIGURE - 3

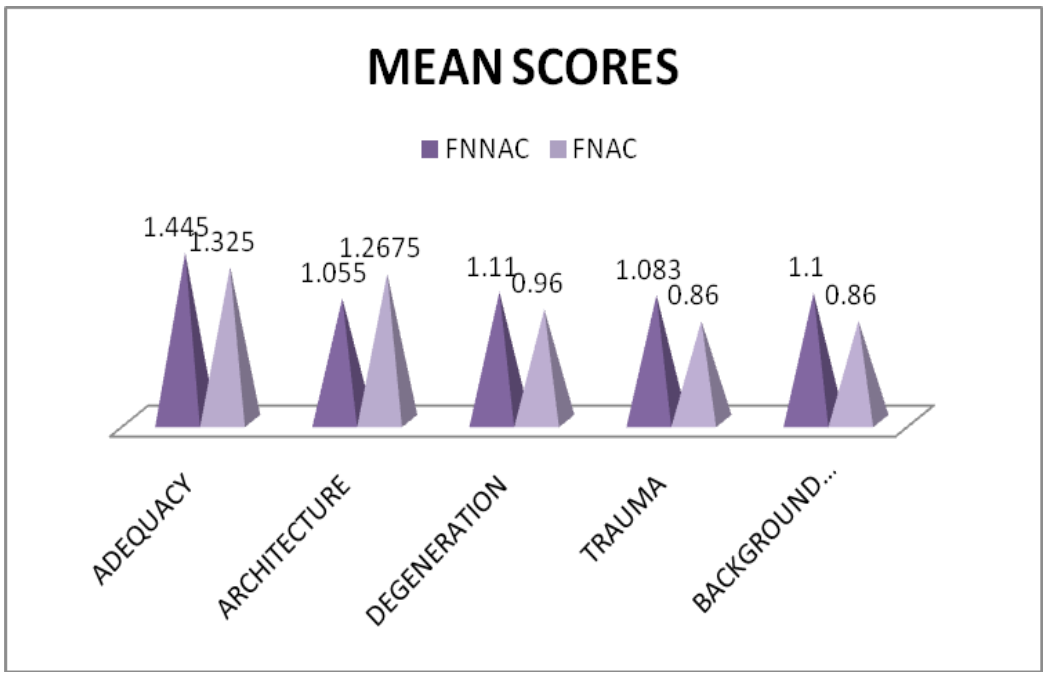
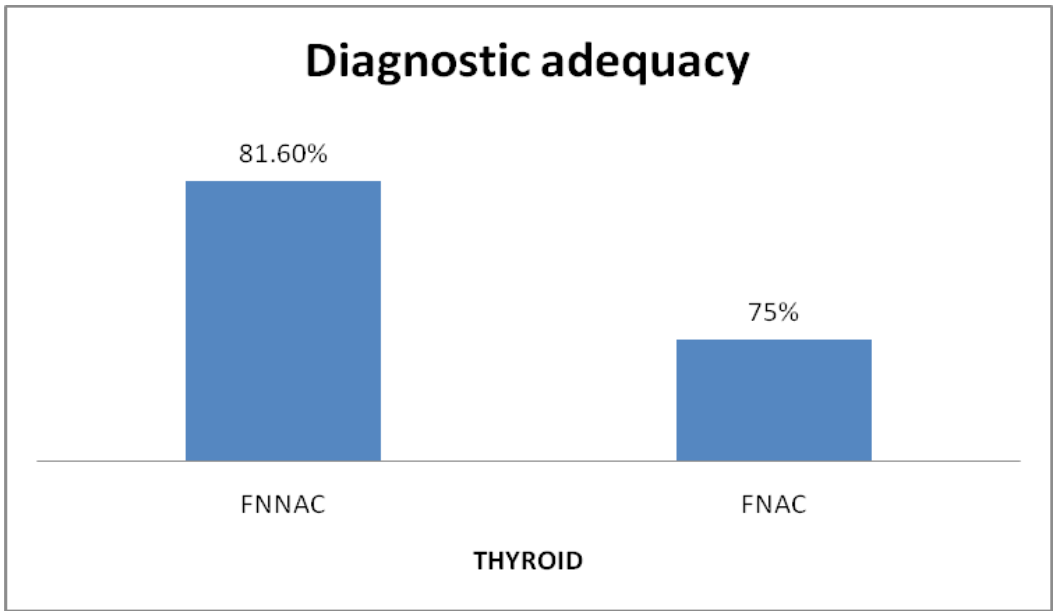


FIGURE – 4 : DIAGNOSTIC ADEQUACY OF EACH TECHNIQUE IN THYROID



The results were compared and analysed using Z test and found to be statistically insignificant, $p > 0.05$.

TABLE - 10

Comparison of the diagnostic adequacy of FNNAC and FNAC : (Thyroid):

FNNAC	FNAC	Standard error of difference between two proportions	Z score	P value
81.6%	75%	7.5	0.8	p>0.05

RESULTS OF FNC OF BREAST

TOTAL CASES - 50

Female - 49

Male - 1

Out of 50 cases sampled from breast lumps, 31 were from fibroadenoma, 4 were from fibrocystic disease, 10 cases were from ductal carcinoma, 3 from phyllodes tumour and 1 each from gynaecomastia and granulomatous mastitis. [Table 12]

TABLE - 11

S.NO	DIAGNOSIS	TOTAL NO.
1	Non neoplastic	6
2	Benign	34
3	Malignant	10
	TOTAL	50

TABLE - 12

S.NO	DIAGNOSIS	Total
1	Fibro cystic disease	4
2	Fibroadenoma	31
3	Phyllodes tumor	3
4	Gynaecomastia	1
5	Granulomatous mastitis	1
6	Ductal carcinoma breast	10
	Total	50

On the basis of total score obtained , smears were graded. It was found that diagnostically superior quality smears were more from FNAC technique than FNNAC (33 vs 28) and the unsuitable smears were also lesser from FNAC technique (1 vs 6) [table 13]. On analysing the results statistically using Z test, it was found to be statistically insignificant, $p > 0.05$ [table 14].

TABLE - 13

S. NO	GRADING OF SMEARS	FNNAC	FNAC
1	Diagnostically unsuitable	6	1
2	Diagnostically adequate	16	16
3	Diagnostically superior	28	33
4	TOTAL	50	50

Comparison of the number of superior quality smears of FNNAC and FNAC from breast lumps :

TABLE - 14

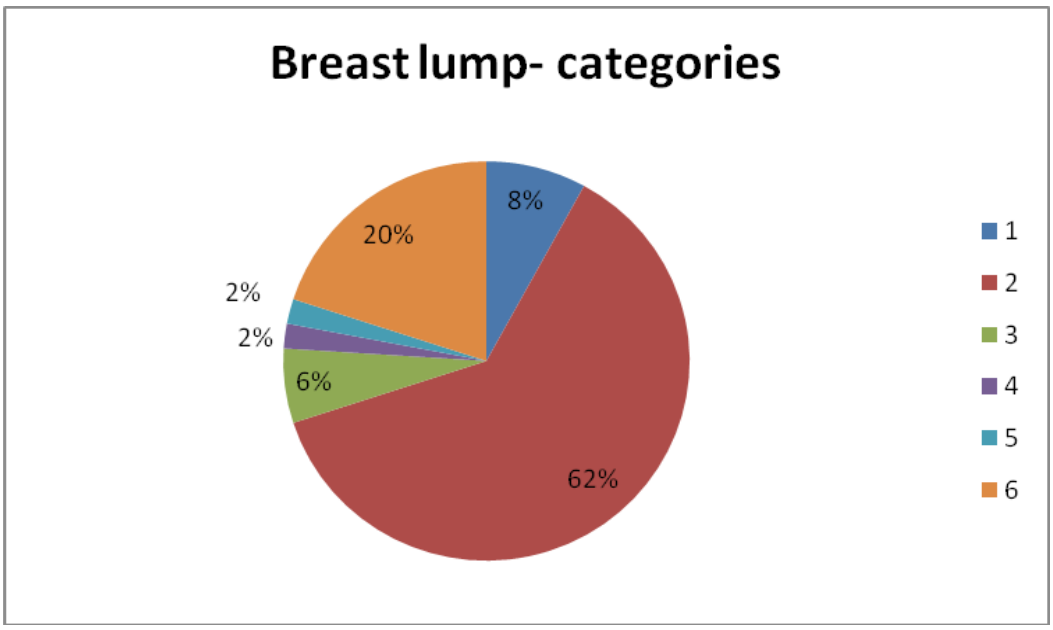
FNNAC	FNAC	Standard error of difference between two proportions	Z score	P value
28	33	9.7	1.030	P> 0.05

The difference is found to be statistically insignificant

TABLE - 15

Total average score		
1	FNNAC	6.64
2	FNAC	7.2

FIGURE - 5



1- fibrocystic disease, 2- Fibroadenoma, 3- phyllodes tumour, 4- gynaecomastia, 5- granulomatous mastitis, 6- ductal carcinoma.

FIGURE – 6 : GRADING OF SMEARS FROM BREAST

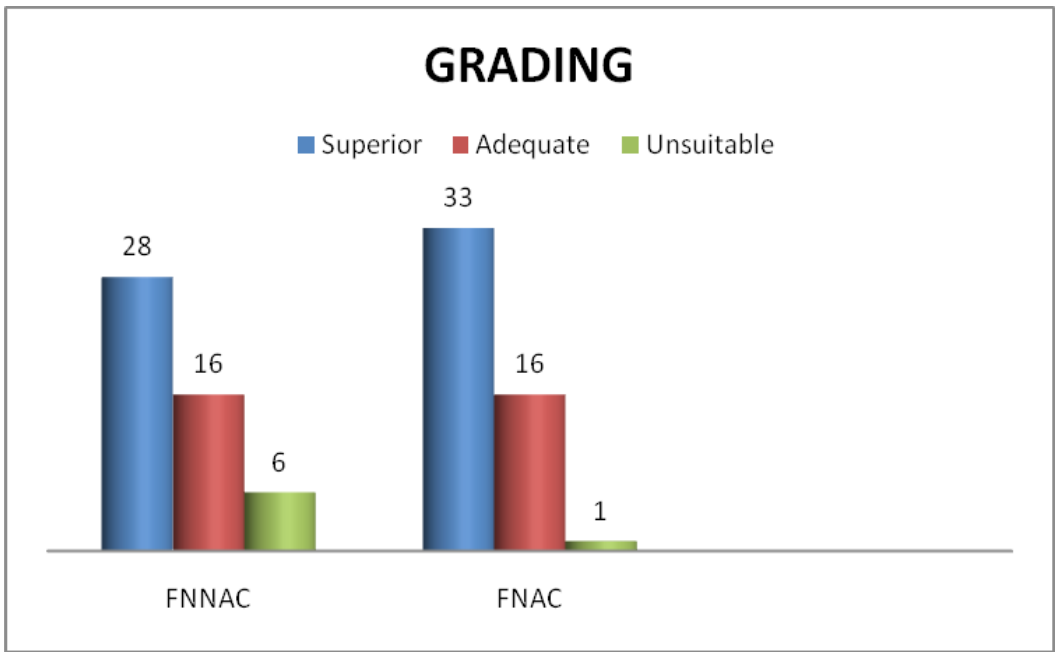


FIGURE – 7 : Average score obtained by each technique under each sub category in breast lesions:

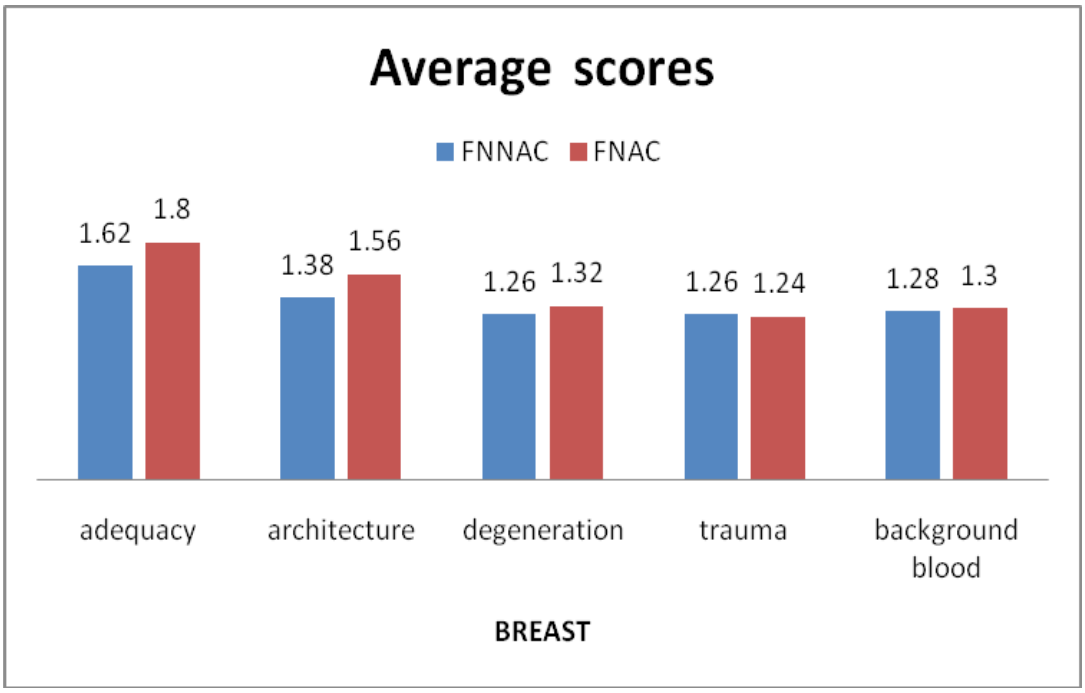
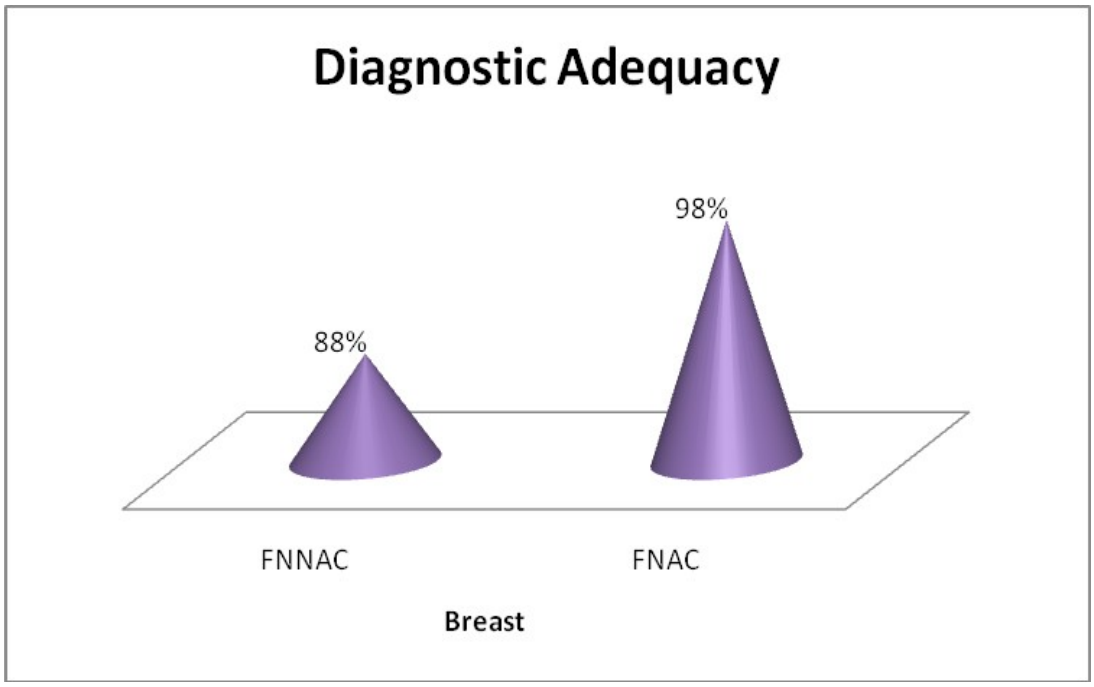


FIGURE 8: Diagnostic adequacy of FNNAC & FNAC



In breast lesions, the total average score obtained by FNAC technique is greater than FNNAC technique (7.2 vs 6.64). The average score for each parameter in FNNAC and FNAC of breast lesions was calculated and it was found that the scores were numerically higher for FNAC technique. [Table 16]

TABLE - 16

Average score obtained by FNNAC & FNAC under each sub category in breast lesions

Average scores						
s. no	**Technique**	**Adequacy**	**Architecture**	**Cellular degeneration**	**Cellular trauma**	**Background blood**
1	FNNAC	1.62	1.38	1.26	1.26	1.28
2	FNAC	1.8	1.56	1.32	1. 24	1.3

TABLE 17

DIAGNOSTIC ADEQUACY OF EACH TECHNIQUE IN BREAST LUMPS

DIAGNOSTIC ADEQUACY		
1	FNNAC	88%
2	FNAC	98%

The results were compared and analysed using Z test and found to be statistically insignificant, $p > 0.05$.

TABLE - 18

COMPARISON OF THE DIAGNOSTIC ADEQUACY OF FNAC AND FNNAC SMEARS OF BREAST LUMPS

FNNAC	FNAC	Standard error of difference between two proportions	Z score	P value
88%	98%	5	2	P>0.05

RESULTS OF FNC OF LYMPH NODE

TOTAL CASES – 50

Male - 24

Female – 26

Out of 50 cases, 21 were metastatic deposits and 29 were reactive and tuberculous lymphadenitis.

TABLE - 19

S.NO	DIAGNOSIS	NO. OF CASES
1	TB & reactive lymphadenitis	29
2	Metastatic carcinomatous deposits	21

On calculating the total average score obtained by FNNAC and FNAC, it was found that the average score obtained by FNAC is greater then FNNAC (7.14 vs 6.66)

TABLE - 20

TOTAL AVERAGE SCORE OF FNNAC AND FNAC IN LYMPH NODE

TOTAL AVERAGE SCORE		
1	FNNAC	6.66
2	FNAC	7.14

According to the scores obtained , smears were graded into three categories as previously mentioned. It was found that the number of superior quality smears from FNAC is 34 whereas 28 were from FNAC. The number of unsuitable smears is also lesser from FNAC technique. On comparing the results , it is found to be statistically significant.[table 21&22]

TABLE - 21

GRADING OF SMEARS IN LYMPH NODE

S no	GRADING	FNNAC	FNAC
1	Diagnostically unsuitable	5	1
2	Diagnostically adequate	17	15
3	Diagnostically superior	28	34
	Total	50	50

FIGURE – 9

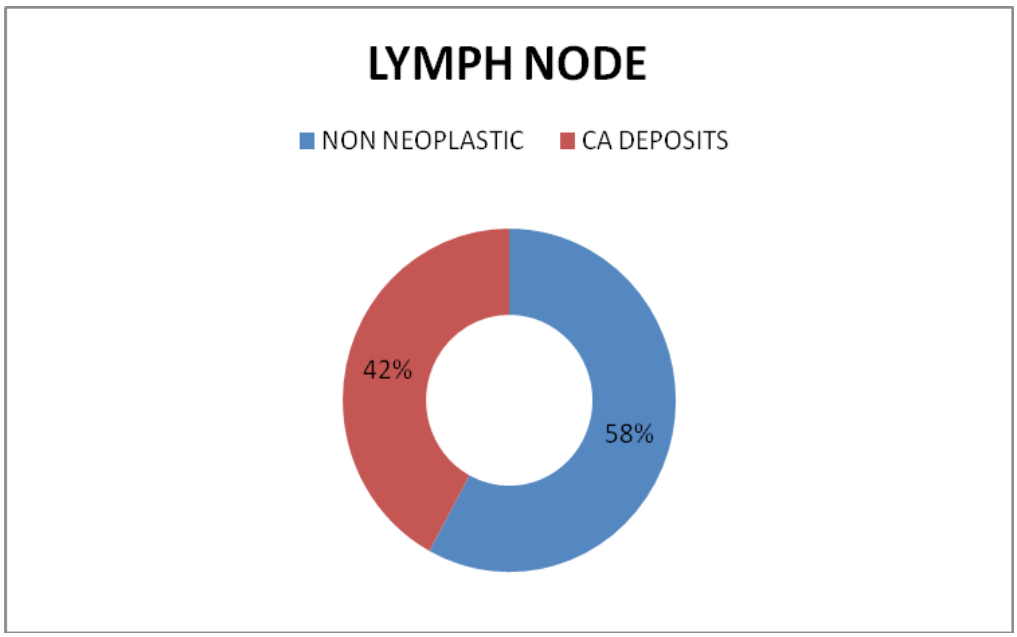


FIGURE – 10 : GRADING OF SMEARS OBTAINED FROM EACH TECHNIQUE IN LYMPH NODE LESIONS

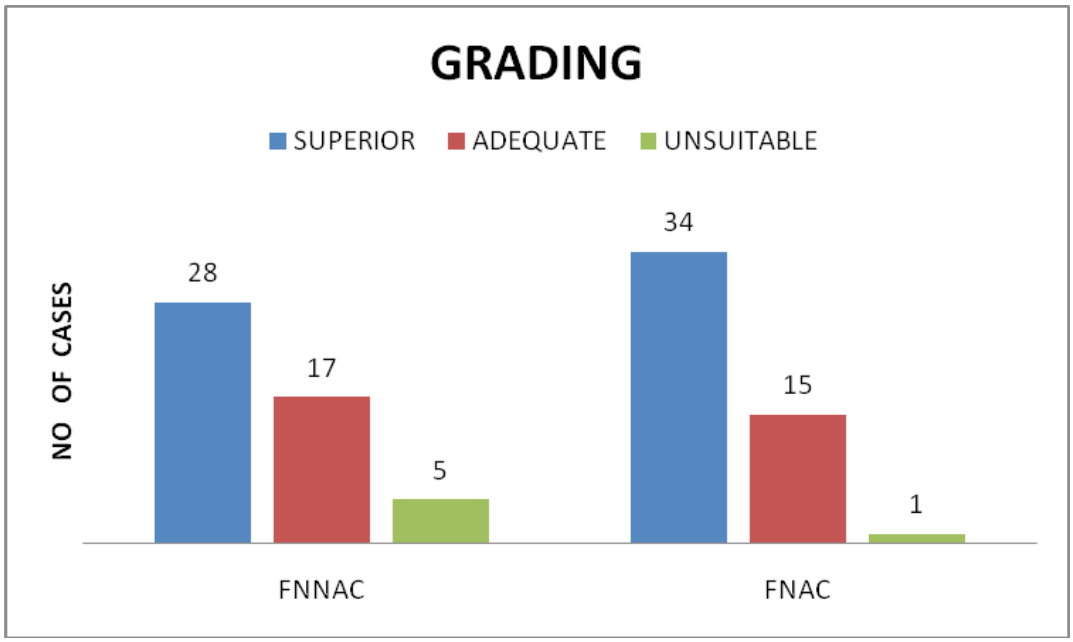


TABLE - 22

COMPARISON OF THE NO. OF SUPERIOR QUALITY SMEARS IN LYMPH

NODE FROM FNAC AND FNNAC

FNNAC	FNAC	Standard error of difference between two proportions	Z score	P value
28	34	9.236	0.519	p> 0.05

The average scores obtained under each parameter is calculated . it is found that the scores were higher for FNAC technique in lymph node lesions. [table 23]

TABLE – 23

S. no	Procedure	Adequacy	Architecture	Degeneration	Trauma	Background blood
1	FNNAC	1.42	1.58	1.14	1.24	1.48
2	FNAC	1.8	1.56	1.32	1.24	1.28

The diagnostic adequacy of FNAC is 98% whereas it is 90% for FNNAC in lymph node lesions.

TABLE - 24
COMPARISON OF THE DIAGNOSTIC ADEUACY OF FNNAC AND FNAC IN LYMPH NODE LESIONS

FNNAC	FNAC	Standard error of difference between two proportions	Z score	P value
90%	98%	4.66	1.709	P> 0.05

The difference is found to be statistically insignificant P> 0.05.

FIGURE - 11

MEAN SCORES OF EACH TECHNIQUE IN LYMPHNODE

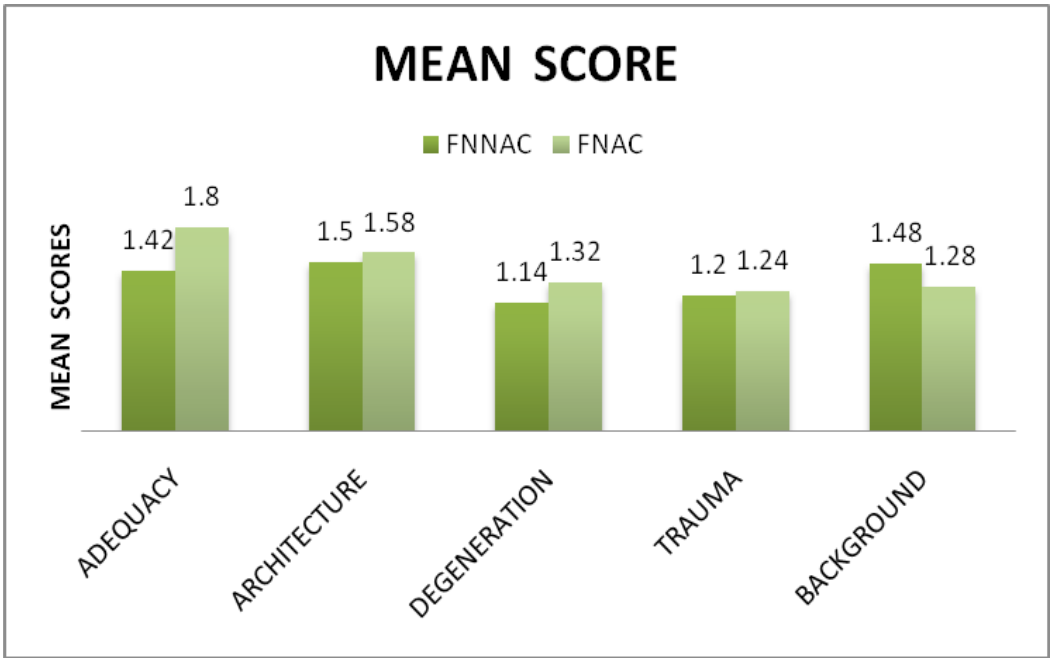
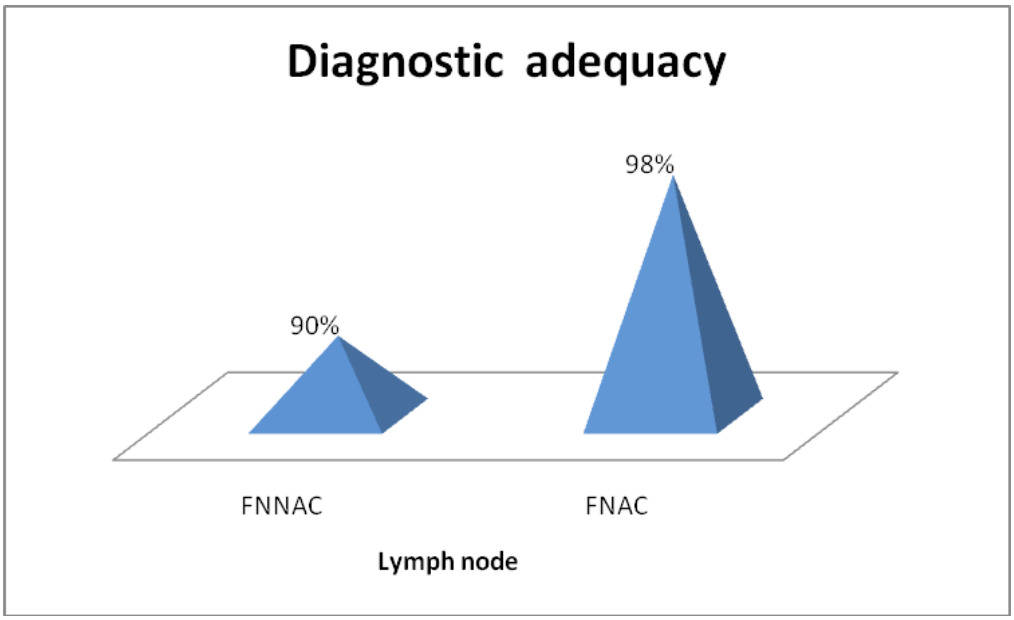


FIGURE - 12

DIAGNOSTIC ADEQUACY OF FNNAC & FNAC IN LYMPH NODE LESIONS



OVER ALL OBSERVATIONS

QUALITY OF SMEARS

Out of 160 cases, 60 were from thyroid , 50 each from breast and lymph node lesions. The overall average score and overall diagnostic adequacy of FNAC & FNNAC for 160 cases was calculated and tabulated below.

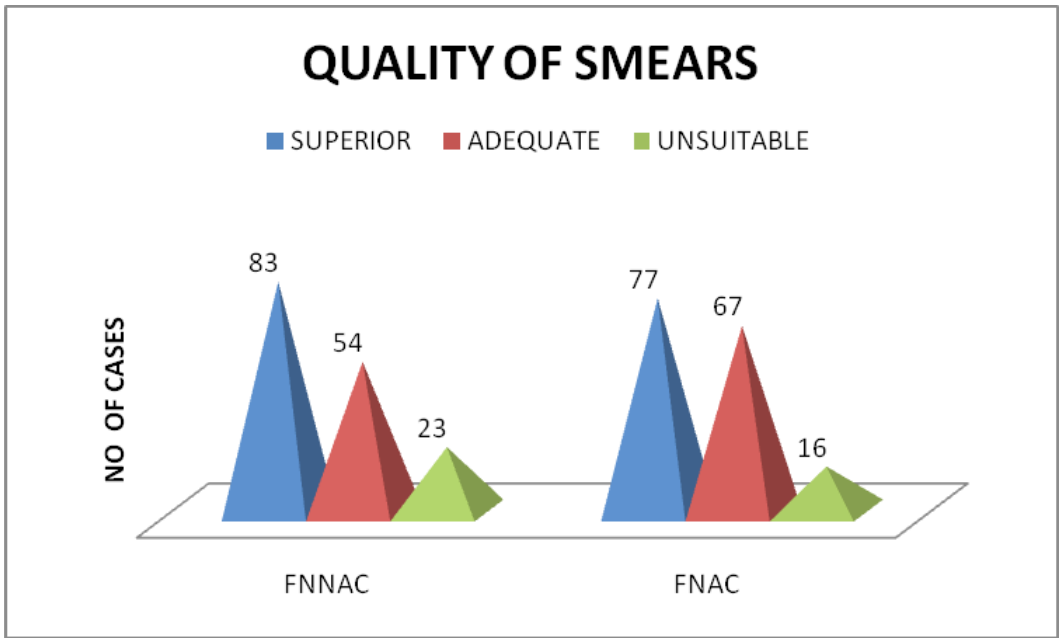
TABLE – 25

S.NO	QUALITY OF SMEARS	FNNAC	FNAC
1.	Diagnostically unsuitable	23	16
2.	Diagnostically adequate	54	67
3.	Diagnostically superior	83	77
4.	Total	160	160

- The number of superior quality smears is more from FNNAC technique than FNAC technique (83 Vs 77)
- The diagnostic adequacy is more in smears from FNAC technique than FNNAC technique (90% Vs 85.65%).
- The average score is found to be slightly higher for FNAC than FNNAC (6.38 Vs 6.3)
- The number of unsuitable smears is found to be in lesser number from FNAC technique in breast and thyroid lesions whereas it is higher in thyroid lesions.

On comparing the results by student's 't' test or Z test . The difference is found to be statistically insignificant

FIGURE - 13



Comparison of the no. of superior quality smears from FNNAC and FNAC in 160 cases :

TABLE - 26

FNNAC	FNAC	Standard error of difference between two proportions	Z score	P value
83	77	5.586	0.67	P> 0.05

The difference is found to be statistically insignificant P>0.05.

TABLE – 27 AVERAGE SCORE

FNNAC	FNAC
6.33	6.38

FIGURE – 14 : OVERALL AVERAGE SCORE OF THE TWO TECHNIQUES

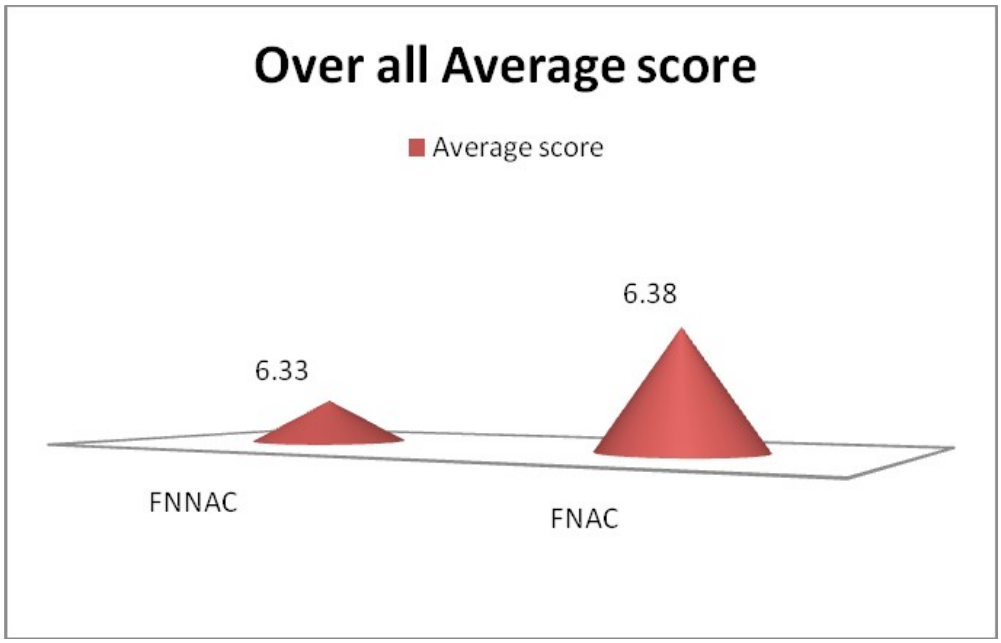


FIGURE – 15 : OVERALL DIAGNOSTIC ADEQUACY IN 160 CASES

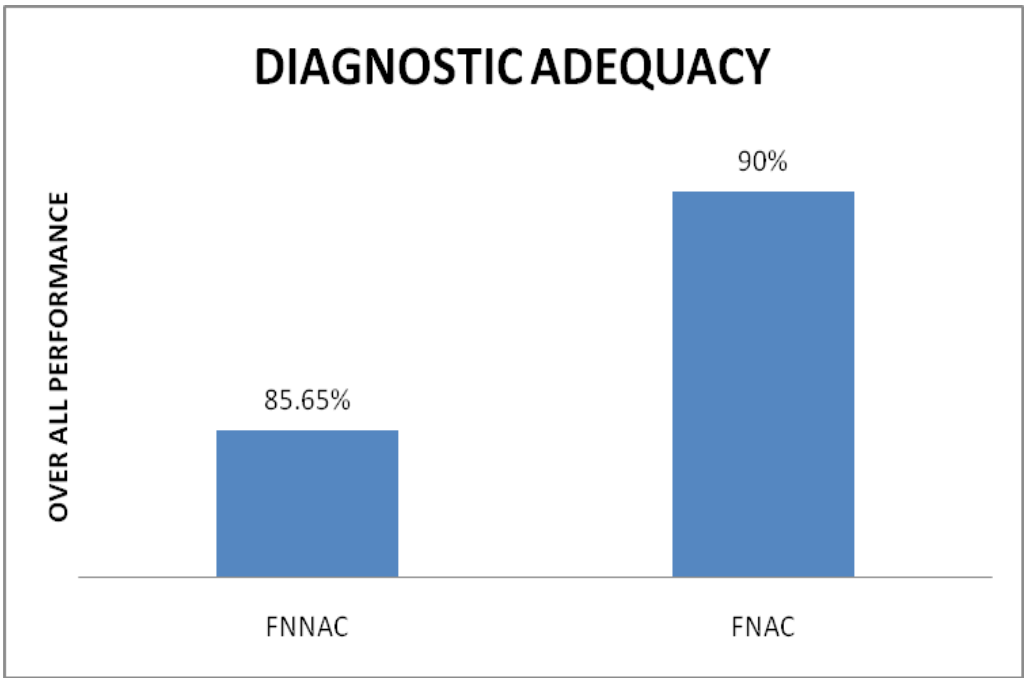


TABLE – 28

Comparison of the overall diagnostic adequacy of FNNAC and FNAC in 160 cases

FNNAC	FNAC	Standard error of difference between two proportions	Z score	P value
85.6%	90%	13.32	0.328	P> 0.05

The difference is found to be statistically insignificant P> 0.05.

OVERALL OBSERVATIONS

TABLE - 29

	FNNAC			
S.no.	**Criteria**	**Thyroid**	**Breast**	**Lymph node**
1	Average score	5.7	6.64	6.66
2	Diagnostic adequacy	81.6%	88%	90%
3	No. of diagnostically superior smears	27	28	28
4	No. of diagnostically adequate smears	21	16	17
5	No. of diagnostically unsuitable smears	12	6	5

TABLE – 30

	FNAC			
S.no.	**Criteria**	**Thyroid**	**Breast**	**Lymph node**
1	Average score	4.8	7.2	7.14
2	Diagnostic adequacy	75%	98%	98%
3	No. of diagnostically superior smears	10	33	34
4	No. of diagnostically adequate smears	36	16	15
5	No. of diagnostically unsuitable smears	14	1	1

It was found that the average score, diagnostic adequacy and the number of superior quality smears were in greater number from FNAC technique than FNNAC technique in breast and lymph node lesions whereas FNNAC technique scored higher in thyroid lesions.

DISCUSSION

Fine needle sampling is currently a widely used technique for cytodiagnosis for various pathological conditions. The basic principle in fine needle aspiration (FNAC) is the aspiration of cellular material from target masses by applying fair amount of suction pressure. An alternative fine needle sampling method (FNNAC), developed in France but remained unnoticed in which tumour cells are obtained through thinner needle by capillary action. In the present study fine needle aspiration and non aspiration techniques are compared with each other to evaluate their efficacy, to find the most suitable method for sites taken for the study like thyroid ,breast and lymph node.

This study included the samples obtained from 160 patients. 60 samples were from Thyroid lesions, 50 samples were from lymph node and 50 samples were from breast lumps.

On the basis of five objective parameters diagnostic adequacy, retention of architecture, degree of cellular trauma, degeneration and background blood. Smears are scored according to scoring system designed by Mair et el in 1989. The number of superior quality smears, total average score , mean score under each sub category and the diagnostic adequacy are compared and analysed statistically using Z test or student's 't' test .

IN THYROID SWELLING

On considering all the observations and results of each technique in thyroid , the number of superior quality smears are more from FNNAC technique (27 Vs 10) and this difference is found to be statistically significant, P<0.05 (table 6). [Figure 16 -31]

TABLE - 31

THYROID				
S.no	**Technique**	**Average score**	**Diagnostic adequacy**	**No. of superior quality smears**
1	FNNAC	5.7	81.6%	27
2	FNAC	4.8	75%	10
3	P value	P >0.05	P >0.05	P<0.05

The number of unsuitable smears are more from FNAC technique. On analysing the mean score under sub categories like diagnostic adequacy, retention of architecture, degree of degeneration, trauma and background blood, scores obtained by FNNAC are numerically higher than FNAC. Mainly the background blood is found to be very less in FNNAC technique. (table 6). On analysing the average scores , the average score obtained by FNNAC was more than FNAC (5.7 Vs 4.8). The diagnostic adequacy is also found to be more for FNNAC technique. (81.66% Vs 75%). On comparing these results of each technique with one another , the difference between them is found to be statistically insignificant (table 9&10).

Although this study showed no statistically significant difference between FNAC and FNNAC with respect to average scores , diagnostic adequacy and reliability of cellular material, irrespective and independent of which procedure was performed first, some practical considerations have emerged.

In the cystic lesions of thyroid like colloid goitre , colloid nodule, and cystic degeneration in a nodular colloid goitre, FNAC is the procedure of choice. It allows the drainage of enough fluid material and it is therapeutic in cases of simple benign cysts. FNAC yielded adequate diagnostic material in such cases.

On considering the superior quality of smears , which is more from FNNAC, ($P<0.05$), for the highly vascular organs like thyroid, FNNAC is the procedure of choice.

This study of comparison of two techniques in thyroid swelling is in concordant with various studies conducted in the past. The observations and the range of scores correlated well with the following studies :

Mair et al[8] in 1989 , S Alirizvee M Hussain *et al* [23] in 2005 , and CV Raghuveer I Leeka et al in 2002[18], Mitchell et al[28] in 2007.

Comparison of the number of superior quality smears obtained by FNNAC & FNAC with other studies:[table 32]

Comparison of the % of diagnostically superior smears obtained by FNNAC & FNAC in thyroid lesions with another study :			
AUTHOR/ YEAR	**FNNAC**	**FNAC**	**P value**
Ali Rizvee et al[23] in 2005	44.7%	45%	P < 0.05
Present study	**20%**	**16%**	**P <0.05 (statistically significant)**

Comparison of the diagnostic adequacy(%) of FNNAC & FNAC in thyroid lesions with other studies :[table 33]

Comparison of diagnostic adequacy(%) in thyroid lesions			
Diagnostic adequacy	**FNNAC**	**FNAC**	**P value**
CV Raghuveer et al[18] in 2002	82.4%	77.9%	P >0.05
Mitchell et al[28] in 2007	87%	89%	p>0.05
Present study	**81.6%**	**75%**	**p> 0.05**

IN BREAST LUMPS

On analysing the results from 50 cases of breast lumps, it was found that in benign breast diseases like fibroadenoma and Phyllodes tumor, FNAC is the most suitable method for the fibrous lesions, since the number of superior quality smears is

more from FNAC [figure 32-35] . The number of unsuitable smears or the failure rate is lower for the FNAC technique. The average score obtained by FNAC is more than FNNAC technique (7.2 Vs 6.64). On analysing the mean score under sub categories like diagnostic adequacy , retention of architecture, degree of degeneration, trauma and background blood, scores obtained by FNAC are numerically higher than FNNAC . The diagnostic adequacy of FNAC is 98% whereas for FNNAC it is 88%. But the difference is statistically insignificant (table 16&17).

TABLE - 34

BREAST				
S.no	**Technique**	**Average score**	**Diagnostic adequacy**	**No. of superior quality smears**
1	FNNAC	6.64	88%	28
2	FNAC	7.2	98%	33
3	P value	P >0.05	P >0.05	P>0.05

In the cystic lesions of the breast like fibrocystic disease, FNAC is the procedure of choice and it allows the drainage of the fluid and can be re-attempted in the residual lesion.[figure 47-50]

In case of the malignant lumps of the breast, both the techniques yielded adequate material and the average scores are comparable. [figure 35-42]

The results and observations of this study from breast lumps , correlated well with the other studies like Sharon Mair et al [8] in 1989.,CV Raghuveer et al[18] in 2002., Amrita Ghosh , Rajivkumar et al [16] in 2000 .

TABLE - 35

Comparison of diagnostic adequacy(%) in breast lesions with another study				
Diagnostic adequacy	No. of cases	FNNAC	FNAC	P value
CV Raghuveer et al[18] in 2002	27	70.38%	85.19%	P >0.05
Present study	**50**	**88%**	**98%**	**p> 0.05**

IN LYMPH NODE

On analysing the results from non neoplastic conditions of lymph node like tuberculosis , reactive lymphadenitis and acute inflammatory lesions, FNAC is found to be superior than FNNAC since the number of superior quality smears are more from FNAC , the number of unsuitable smears are lower ie., the failure rate is lower from FNAC technique.[figure 51-54] On analysing the mean score under sub categories like diagnostic adequac , retention of architecture, degree of degeneration and trauma, scores obtained by FNAC are numerically higher than FNNAC except the background blood which is found to be very less in FNNAC technique . The diagnostic

adequacy is more for FNAC than FNNAC (98% Vs 90%)(table24).

TABLE - 36

LYMPH NODE				
S.no	**Technique**	**Average score**	**Diagnostic adequacy**	**No. of superior quality smears**
1	FNNAC	6.66	90%	28
2	FNAC	7.14	98%	34
3	P value	P >0.05	P >0.05	P>0.05

On comparing the results from lymph node involved by metastatic carcinomatous deposits , both the techniques are applicable as they yielded comparable results but the average score obtained by FNNAC technique is more than FNAC but statistically insignificant (p>0.05) [figure 55-62].

The results and observations correlated with other studies like Sharon Mair et al [8] in 1989, Kumarasinghe MP , Sheifdeen et al[12] in1995, Salim Akhthar , Imran ul Huq et al[14] in 1997, CV Raghuveer, I Leeka et al [18] in 2002,Yasub E Al Khattab et al [22] in 2004

TABLE - 37

Comparison of diagnostic adequacy(%) in lymph node lesions with other studies			
Diagnostic adequacy	**FNNAC**	**FNAC**	**P value**
Dey P and Ray R et al[10] in 1993	95.34%	81.4%	P < 0.05

Braun H et al [15] in 1997	51.2%	51.8%	p > 0.05
CV Raghuveer et al[18] in 2002	85%	87.59%	P > 0.05
Present study	**90%**	**98%**	**P > 0.05**

On analysing the overall performance of FNNAC and FNAC in 160 cases, it is found that , (table 25,26,27,28):

The number of superior quality smears is more from FNNAC technique than FNAC technique (83 Vs 77)

1. The diagnostic adequacy is more in smears from FNAC technique than FNNAC technique (90% Vs 85.65%).

2. The average score is found to be slightly higher for FNAC than FNNAC (6.38 Vs 6.3)

3. The number of unsuitable smears is found to be in lesser number from FNAC technique in breast and thyroid lesions whereas it is higher in thyroid lesions.

On comparing the results by student's 't' test or Z test . The difference is found to be statistically insignificant .

SUMMARY AND CONCLUSION

This study has been attempted at comparing the efficacy of the two techniques of fine needle sampling ie.,(FNAC and FNNAC) in the sites thyroid , breast and lymph node on the basis of scores obtained by each technique under the categories diagnostic adequacy, retention of architecture, degree of cellular degeneration, degree of cellular trauma and amount of blood or clot obscuring the background.

On analysing the number of superior quality of smears obtained from each technique in thyroid lesions , it is more from FNNAC technique. The difference is also found to be statistically significant , P value < 0.05 (table 6).

On analysing and comparing the average scores obtained by each technique and by comparing the diagnostic adequacy of each, the difference is found to be statistically insignificant ($p>0.05$) at all the three sites included in the study.

This study concludes that although the results are not statistically significant it is found that :

For highly vascular organs like thyroid , FNNAC is the preferred technique as there is more material with less admixture of blood.

The superior quality smears without admixture of blood is more from FNNAC. FNAC smears although diagnostic in a greater number of cases , mostly produced adequate rather than superior quality smears (table 25).

For the cystic lesions of thyroid , breast and lymphnode , FNAC is the procedure of choice as it allows the drainage of fluid material and therapeutic in some cases and yield more diagnostic material.

For the fibrous lesions of breast like fibroadenoma & Phyllodes tumour, FNAC is the best choice as it yielded adequate material than FNNAC.

For the malignant lumps of breast both the techniques are comparable and yielded adequate material.

For the non neoplastic lesions and metastatic deposits in a lymph node, both FNAC and FNNAC yielded adequate material but the high quality smears and the success rate is more from FNAC technique .

The decision to use either FNNAC or FNAC may be decided on the basis of site, size and nature of lesion (solid or cystic). In conclusion each technique has its own advantages and disadvantages. Both the techniques can be combined to obtain a high quality material and to lower the failure rates.

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KEY TO MASTER CHART

FNAC	–	Fine needle aspiration cytology
FNNAC	-	Fine needle non aspiration cytology
M	-	Male
F	-	Female
A	-	Amount of cellular material
B	-	Degree of retention of architecture
C	-	Degree of cellular trauma
D	-	Degree of cellular degeneration
E	-	Amount of background or clot
NCG	-	Nodular Colloid Goitre
HT	-	Hashimotos Thyroiditis
FN	-	Follicular neoplasm
CCN	-	Cystic colloid nodule
Pap CA	-	Papillary Carcinoma of thyroid
TG cyst	-	Thyroglosal cyst
CG	-	Colloid goitre
TB LN	-	Tuberculous lymphadenitis
RFH	-	Reactive Follicular Hyperplasia
GL	-	Granulomatous lesion
SCC D	-	Squamous cell carcinomatous deposits
AC D	-	Adeno carcinomatous deposits
FA	-	Fibroadenoma
FCD	-	Fibrocystic disease
PT	-	Phyllodes tumour
CA	-	Ductal carcinoma
GM	-	Granulomatous mastitis.